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Villagization and access to water resources in the Middle Awash Valley of Ethiopia: implications for climate change adaptation

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ABSTRACT

Since the 1970s, the Government of Ethiopia has implemented villagization, whereby nomadic pastoralist groups are supported to develop (more) sedentary lifestyles and livelihoods. Villagization has been officially promoted to encourage diversification from livestock herding to agricultural cultivation, and to fulfil basic needs through infrastructure and services. From the late 2000s, villagization was reintroduced for arid and semi-arid regions as a strategy for adaptation to climate change, as part of the country's green growth agenda. The aim of this paper is to evaluate to what extent this phase of villagization has contributed to adaptation strategies among pastoral and agro-pastoral communities, based on an empirical analysis of four villagised sites in the Middle Awash Valley using qualitative data collected between 2014 and 2018. Perceptions and experiences of villagization varied across individuals, households, villages, and districts. While villagization has generally delivered infrastructure and services, and offered income diversification to those able to access irrigated agriculture, its implementation has been partial and uneven, and it has reproduced previous problems of resource scarcity while creating new risks and vulnerabilities. We argue that villagization may play a role in some aspects of adaptation, if programmes address the drivers of livelihood change, and embed equity and rights.

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1. Introduction

Ethiopia and other countries of sub-Saharan Africa are inhabited by significant populations of pastoral people who practice traditional nomadic livestock herding. In Ethiopia, pastoralists own all the available camels, three quarters of the goats, one quarter of the sheep, and one fifth of the cattle (Gebeye, 2016). Most of the livestock that is used for domestic meat and export comes from pastoral areas, with the livestock sector second to coffee in generating foreign currency for Ethiopia (Gebeye, 2016).

However, the practice of pastoral livelihoods, the number of and type of animals, and livestock production and productivity have gradually diminished over time. Pastoralist lifestyles in arid and semi-arid regions of Ethiopia are increasingly impacted by environmental and anthropogenic drivers, which have contributed to the degradation of the rangeland and water resources upon which they depend. Environmental drivers include increased rainfall variability, and more frequent and severe droughts, floods (Müller-Mahn, Rettberg, & Getachew, 2010) and invasive plant species (e.g. *Prosopis juliflora*) (Mehari, 2015). Anthropogenic drivers include population growth, the absence of land use planning (Rettberg, 2010), and the expansion of commercial agriculture (Abbink et al., 2014). Several studies indicate that pressure on natural resources in semi-arid and arid regions is increasing, while the adaptive potential of these ecosystems and their populations is declining (e.g. Müller-Mahn et al., 2010). Pastoral groups thus experience increasing levels of poverty, socio-political-economic marginalization, lack of access to infrastructure and services, water and food insecurity, high levels of rural-urban migration, and inter-community conflicts (Hassen, 2008; Reda, 2014). Therefore, the literature indicates a mutually-reinforcing relationship between these processes, whereby the effects of environmental and human change enhance forms of social, economic and political marginalization, which in turn further exacerbate the vulnerability of pastoral livelihoods to environmental change. Some studies indicate the contribution to the decline of the practice of traditional subsistence pastoralism in sub-Saharan Africa (Manoli et al., 2014; Mortimore, 2010). The need for urgent and effective development initiatives that support the resilience of pastoral and agro-pastoral communities, in particular vis-à-vis their ability to adapt to climate change, has thus emerged as an important policy objective.

Amid these environmental and political-economic changes, in the late 2000s the government of Ethiopia designed and implemented a new and revised phase of the villagization programme, which was targeted at the arid and semi-arid regions of the country and focused on the development of water resources (FDRE, 2013). Although villagization dates back to the 1970s in Ethiopia (Messay, 2009), this new version of villagization was implemented in the arid and semi-arid regional states of Oromiya, South Nations, Nationalities and Peoples, Somalia and Afar (FDRE, 2013). The programme aimed to provide basic infrastructure and services (schools, health facilities, rural roads, electricity)

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for pastoral and agro-pastoral communities as before, but also encompassed the development of water resources for potable water supply and irrigation (MoFA, 2013). This new phase of villagization thus aimed to establish new villages on a voluntary basis near water sources with the primary objective of transforming pastoral livelihoods into agro-pastoralism by introducing irrigated agriculture. Given the economic and cultural importance of livestock to pastoralists, it also planned to modernize their herds by seeking to improve livestock varieties and feeding habits and reduce the number of animals. Thus, the stated overall goal of villagization was to enhance the livelihood resilience of pastoral communities in drought prone areas by improving food security, diversifying income sources, and delivering better social services (FDRE, 2013).

However, villagization in Ethiopia has been highly contested. Some studies contend that villagization was planned to favour the introduction and expansion of new state-owned and private commercial agriculture (see Lavers, 2012; Reda, 2014; Cochrane & Skjerdal, 2015; Gebeye, 2016). These studies also suggest that villagization constituted a mechanism of land grabbing by the state and private sectors at the expense of pastoralist people, since it is claimed to have resulted in the scarcity of grazing land, reduced access to customary pasture and water sources, and restricted movement corridors to practice pastoralism. The villagization programme was thus criticized for its potential negative impacts on the well-established pastoralist livelihood system, culture, and indigenous knowledge. Instead of developing and improving pastoral livelihoods, it is argued, villagization imposed a sedentary life-style that was incompatible with these people's traditions, and that was instead more strongly related to the view of some governments of sub Saharan African countries that pastoralist lifestyles are backward and in need of modernization through development interventions (Behnke & Kerven, 2013; Dong et al., 2011; Elias & Abdi, 2010; King-Okumu, Wasonga, & Yimer, 2015). Therefore, a number of scholars assert that villagization is not a feasible development option for pastoral communities (Lavers, 2012; Reda, 2014; Gebeye, 2016).

Acknowledging this contested nature of villagization, and the context of its reframing as an adaptation strategy, this study set out to examine to what extent villagization has contributed to adaptation to climate change among pastoral communities in the Middle Awash Valley. We assessed the perceptions and experiences of pastoral communities with regard to the outcomes of villagization with particular reference to the provision of, access to, and use of water resources and the impacts on their lifestyles and livelihoods. This paper, therefore, provides empirical evidence to inform academic and policy debates on the effectiveness of resettlement schemes in transforming pastoral livelihoods towards resilience. It also offers some useful insights for Ethiopian federal and regional policy makers and practitioners who have been implementing the programme at the grassroots levels in arid and semi-arid areas of the country.

2. Villagization and adaptation to climate change in Ethiopia

Villagization, which is considered as the resettlement of people into new designated villages or sites, is not a new phenomenon in Ethiopia. Past governments have implemented villagization programmes for rural communities since the 1970s (Messay & Bekure, 2011). Notably, the programme was scaled up between 1984 and 1986, when the government settled 13 million rural communities into villages (Daie, 2012). Some of the officially stated objectives of villagization during this time were to rehabilitate and ease population pressure on the severely degraded northern parts of Ethiopia; to enable the provision of potable water supply, health and education; to enforce land use planning; and to strengthen peace and security in rural areas. However, the villagization programme implemented during that period failed to achieve the intended outcomes, and was criticized for being involuntary, unable to provide key economic resources such as water and pasture, and also for accelerating the spread of communicable diseases and crop pests and diseases (Daie, 2012). In the early 1990s, the government officially abandoned villagization in line with its shift from a centrally-planned to a mixed economy (FDRE, 2013).

In the late 2000s, however, the new government reintroduced a modified form of villagization, envisaged as voluntary and aimed at selected arid and semi-arid regions of the country. The government planned to villagise 1.5 million pastoralists and agro-pastoralists in five regional states (Afar, Gambela, Oromia, South Nations, Nationalities and Peoples, and Somali) during the first five-year period of the Growth and Transformational Plan (2010–2015) (FDRE, 2012, 2013). This phase of villagization was part of the Regional Pastoral Livelihood Resilience Project (RPLRP), which was designed by the Ethiopian government to enhance the resilience of arid and semi-arid communities to climate-related shocks, and improve the provision of infrastructure and services to make progress towards the Millennium Development Goals (FDRE, 2012). The underlying assumptions were that Ethiopia's arid and semi-arid regions had a more acute set of social, economic and environmental challenges: poor provision of basic infrastructure and services (e.g. education, health, water supply, transport, electricity); high vulnerability to recurrent droughts and environmental hazards (e.g. flash floods, invasive species); high dependence on extensive livestock production with poorly developed support services, demand for natural resources (pasture, water), and poor access to markets; and constrained mobility due to large-scale development schemes, land reallocation, and more rigid international borders (FDRE, 2013). Thus, as part of the first Growth and Transformation Plan, and in line with the country's Climate Resilient Green Economy agenda, the government initiated a new phase of voluntary villagization programme with the dual official goals of improving the provision of social services to pastoral communities in arid and semi-arid lands regions, and mitigating climate-related shocks and promoting adaptation (FDRE, 2012).

The plan for this phase of villagization was to establish new villages near to water sources. This would require the installation of new water infrastructure, including drinking water points (e.g. boreholes) and potable water systems, and irrigation canals to enable the introduction of irrigated agriculture and localized livestock rearing. This infrastructure was sometimes installed alongside new development projects, such as industrial commercial agriculture, for which the new villages

would also form sources of labour. Furthermore, the government promised to prepare agricultural fields, supply agricultural inputs, establish market linkages for agricultural products, and establish farmer training centres. The plan also included the aim to modernize and improve the livestock sector by improving fodder production through irrigated farming and introducing better livestock breeds. Besides these features, the programme entailed a similar format as previously, encompassing the construction of basic infrastructure such as potable water supply, schools, health centres, and electricity, thereby enabling Ethiopia to potentially improve its human development indicators in its poorest regions.

Government documents (FDRE, 2012, 2013) and other studies (Haile, 2017; Reda, 2014) indicate that the government held a number of discussions and consultations on villagization with various stakeholders at national, regional, *woreda* (district), *kebele* (village) and community levels. State officials at the federal and local levels also claim that, prior to implementation, pastoral communities were informed about the nature, implementation processes and the expected benefits of the programme. The government was also expected to pay compensation to communities who were resettled because their pastoral communal land was appropriated for development projects (Reda, 2014).

Therefore, this phase of villagization marks a shift from previous programmes, which have been examined in the literature as noted in the previous section. While the development dimensions are similar in envisaging the 'modernisation' of pastoralists, the programme links with both the climate change adaptation and the economic growth agendas of the country, envisaging a form of win-win-win scenario between these elements. However, as noted by recent studies, sedentary based development and adaptation initiatives for pastoral areas can be counterproductive to the lifestyles, livelihoods and cultures of pastoral people (Behnke & Kerven, 2013; Dong et al., 2011; Elias & Abdi, 2010; Gebeye, 2016; King-Okumu et al., 2015), as well as less suited to arid environments and less economically viable than existing pastoralism (Behnke & Kerven, 2013; Cochrane & Skjerdal, 2015; Gebeye, 2016). In this regard, our study carefully considers the nature and implementation of the new phase of villagization, and the perceptions and experiences of the communities, acknowledging that it is the pastoralists who are expected to undergo the most significant transformation as part of this programme.

3. Materials and methods

3.1. Description of the study area

The study was conducted in the Middle Awash Valley (MAV) of the southern Afar regional state. Data were collected from two *woredas* (administrative districts), namely Awash Fentale and Amibara. The study areas are located between 8°46' and 9°51' N and 39°40' and 40°40' E (Figure 1), and have areas of 1,046.41 km^2 and 2,007.05 km^2, respectively. The topography of this area is generally flat with a maximum altitude of upto 1,000 m above sea level.

The climate of the area is hot and semi-arid. The mean annual temperature is estimated at 27.9°C. The mean annual total rainfall and evapotranspiration are estimated at 573.4 and 2801.1 mm, respectively. Precipitation is generally scant, irregular, and unpredictable and seems to follow a bimodal pattern that occurs in February-April and July-August (Figure 2a). As observed, the rainfall for 20 out of 35 years was below the

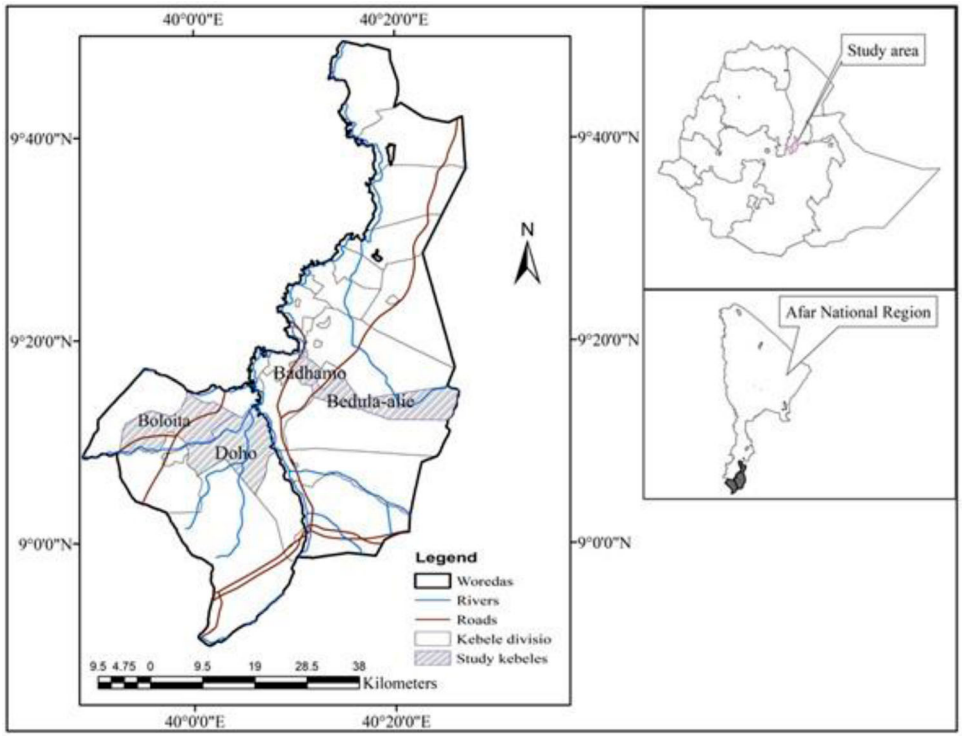

Figure 1. Study sites in Amibara and Awash Fentale *woredas*, Afar Regional State, Ethiopia. Source: produced with data from Ethio GIS.

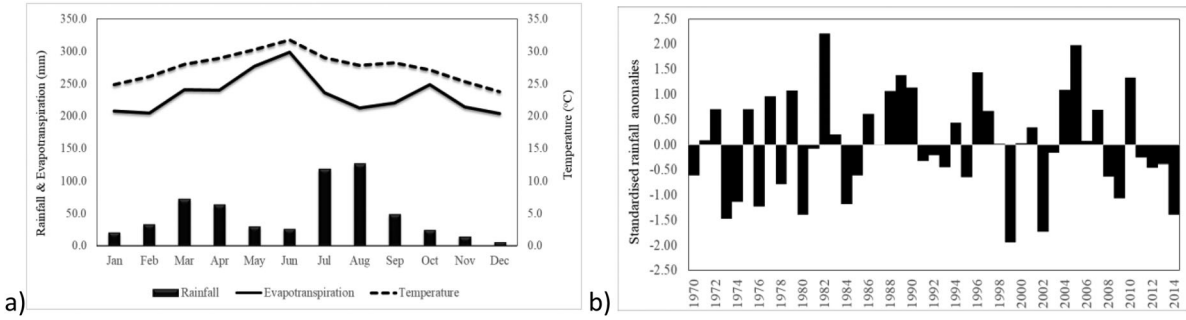

Figure 2. Climate variability for the study area; (a) mean monthly rainfall, temperature and evapotranspiration levels, and (b) Standardized Rainfall Anomalies. Source: produced from climate data provided by the Worer Agricultural Research Center.

long-term average (Figure 2b). Throughout this period (both months and years), the level of evapotranspiration was higher than that of precipitation. This area is further characterized by frequent drought and flood episodes which affect the ecosystem and livelihoods (Rettberg, 2010). The study area is traversed by the Awash River and its tributaries (Bulga, Kebena and Kesem), which are sources of water for human and livestock consumption (ARBA, 2013).

The main types of soils in the study area are Cambisols on hilly slopes and Fluvisols on flatter areas and along river courses (Haregeweyn & Tsunekawa, 2013). Vegetation cover includes grassland, open bush land and forest along perennial river courses. Significant areas of native grasslands, shrub lands and woodlands have been affected by the invasive species, *Prosopi juliflora* (Wakie, Laituri, & Evangelista, 2016).

The inhabitants of the Middle Awash Valley are largely from the Afar ethnic group. Pastoralism has been the main livelihood system for centuries in the study area and elsewhere in the Afar Region (Rettberg, 2010). Camel, cattle, goat and sheep are the principal animals raised for milk, milk products, meat, sale of offspring, and socio-cultural uses. Over 90% of the Afar people depend on milk and milk products for their diet and income generation (AfNRS, 2010; Hassen, 2008). However, pastoral livelihoods in this area are significantly challenged by shortages of grazing land caused by both climatic and anthropogenic factors, as mentioned earlier (Hassen, 2008). Since the 1950s, some of the customary communal grazing land has been converted into large-scale state-owned irrigated agriculture, including export-oriented sugarcane plantations and the associated Kessem Sugar Factory that was established in 2010 in Awash Fentale *woreda* (Hail, Nega, & Atlaw, 2016).

3.2. Data sources and methods

Our study is based on empirical data collected between 2014 and 2018 from four villagised *kebeles* (villages) purposely selected from Awash Fentale and Amibara *woredas* (Table 1). Data related to the processes of villagization and its impacts were collected from 102 participants using focus group discussions (FGDs) and key informant interviews (KII) held with local communities and officials from local governmental and non-governmental institutions. We also conducted field observations at the villagised sites to assess the nature, extent and quality of the basic infrastructure, water resources development, and levels of support in the villagization projects.

Table 1. Description of the villagised *kebeles* (villages) studied.

Name of the study site	*Woreda*	Latitude	Longitude
Boloita	Awash Fentale	09°12′20.09″	39°57′50.39″
Doho	Awash Fentale	09°11′0.5″	40°07′04″
Badahamo	Amibara	09°17′34.41″	40°11′17.25″
Bedula-alie	Amibara	9° 18′ 42.9″	40° 11′ 34.8″

A total of eight FGDs (two per *kebele*), each containing at least eight participants spread across men and women, and elders and youths, were conducted in February and March 2017. FGDs were used to generate data on peoples' perceptions and experiences regarding: the process of villagization, water and rangeland resources, development of basic infrastructure, availability and access to water for domestic use and irrigation, and related challenges in the new villages. Discussion was also held on the impacts of villagization and irrigated farming on livelihoods (income diversification, food security, and poverty reduction) and its implications for disaster risk management and adaptation to climate change. In addition to the FGDs, we conducted semi-structured Key Informant Interviews (KII) with selected members of the pastoral communities, *kebele* leaders and development agents, and *woreda* officials from the administration and different sectors (agricultural and pastoral extension, irrigation and water management, disaster preparedness and risk management, and land administration), from 2014 to 2018. We also conducted interviews with agricultural and water management officials at the Worer Agricultural Research Center, Ethiopian Sugar Corporation, and ARBA. Additional interviews were held with representatives of international institutions (e.g. the UN Food and Agriculture Organisation (FAO), and FARM-Africa). The topic of KIIs with *woreda* officials focused on the planning, preparation and type of support that their offices provided in the implementation of villagization programme, monitoring and evaluation mechanisms to assess its impacts, and their assessment of any challenges and opportunities associated with the projects.

The qualitative data collected using FGDs and KIIs were analysed through thematic coding and have been presented in the form of descriptive narratives. To support our analysis, we have also presented some relevant quotes from the respondents, anonymising their identities.

4. Results and discussions

4.1. Overview of the implementation of villagization in the Middle Awash Valley

Villagization was implemented from 2010 in both Awash Fentale and Amibara *woredas*. The villages were established along the Awash River, where existing and newly-constructed irrigation canals enabled the introduction of irrigated agriculture and on-site livestock rearing (MoFA, 2013). Irrigation was primarily targeted at the sugarcane plantations, which would also require significant labour, intended to come at least in part from the new villages. However, its implementation varied across the two *woredas* in terms of the processes undertaken (e.g. consultation during planning and implementation), the nature of the project (e.g. type of houses, source of sponsor and agent for house construction, compensation payment for land, size of land distribution and market linkage), and the institutions that were involved (see Table 2).

4.1.1. Villagization in Awash Fentale

In Awash Fentale *woreda*, the villagization projects and development of irrigation for the pastoral community were attached to the state-sponsored large-scale sugarcane plantation and the associated Kesssem Sugar Factory (KSF), which was developed on fertile rangeland, including pastoral communal land and mature forest. The plan was to implement the programme in four *kebeles* (Boloita, Doho, Kebena, and Saburie), whereby each villagised household would receive 1.25 hectares of irrigable land, on which they were expected to grow sugarcane on about 1 ha and other crops of their choice on the remaining area, and the basic infrastructure and services promised as part of villagization. Households in Boloita and Doho reported that they were generally informed and consulted about the development of the sugarcane plantation and the related villagization programme prior to its implementation. According to them, a list of promises were made by the government: compensation for expropriated land until the operation of irrigated farming; modern rangeland near to the new settlement; provision of standard houses; employment opportunities both in the sugarcane plantation and KSF; provision of basic infrastructure and services (potable water, health clinics, schools, farmer training centres); provision of free agricultural inputs and farming services; and provision of market linkages for their agricultural products. These promises generated made the pastoralists positive about the programme and the prospect of a better way of life, and for this reason the communities did not oppose the reallocation of their land to the sugarcane plantation.

In this *woreda*, the Administration office took responsibility for distributing land to the villagised households, and providing agricultural inputs and extension services to the community (Table 2). The Ethiopian Sugar Corporation then took responsibility for managing much of the implementation, including house construction, land preparation for sugarcane plantation and provision of sugarcane seedlings, water distribution for irrigation and potable water supply, and construction of other infrastructure (schools, health posts, farmer training centres) (see Table 2). The Corporation was also responsible for rangeland development and creation of job opportunities for villagers. Some villagised inhabitants were directly employed by the corporation, while each household was expected to sell their sugarcane crop to the KSF, thus taking advantage of the new market linkage offered. There were, however, variations between the villagised *kebeles* (hereafter 'village'). For example, the government constructed houses for villagers in two *kebeles* (Doho and Saburie), whereas this was not the case for the other two (Boloita and Kebena). In Doho, houses were constructed from cement bricks with iron roofs (Figure 3a), whereas in Saburie they were made from lower-quality wood and mud with iron roofs (Figure 3b). In some cases, the promise of allocating land for irrigation was not fulfilled or the process was delayed.

4.1.2. Villagization in Amibara

In Amibara *woreda*, villagization was implemented in 15 out of 19 rural *kebeles*, on sites close to the Awash River and the state irrigation canals. In contrast to Awash Fentale, there was no link to an external development project, and, while land for settlement and irrigated agriculture was offered, the villagers were neither offered relocation or land compensation payments

Table 2. Main institutions and actors in the implementation of villagization at the *kebele* level, Middle Awash Valley.

Woreda	Institutions and actors	Roles and contribution
Amibara and Awash Fentale	*Woreda* Administration Office	Lead and organize the planning and implementation of villagization.
	Woreda Health Office	Establish health centres and provide required material and human resources.
	Woreda Education Office	Develop schools and provide material and human resources.
	Woreda Water Office	Develop water points and provide maintenance for water points.
	Woreda Women and Youth Office	Ensure participation and equitable benefits to women and youth groups.
	Worer Agricultural Research Center	Develop and introduce agricultural technologies (e.g. drought resistant and locally growing crop varieties, forage varieties, and hybrid livestock), provide training and conduct research on irrigated farming.
Awash Fentale	*Woreda* Land Administration Office	Distribute irrigable land to villagised households after receiving prepared land from the Kessem Sugar Factory.
	Woreda Agricultural Office	Provide agricultural inputs, training on crop farming and application of inputs, and offer advice on livestock breeding, veterinary service, rangeland development and resource management to villagised households.
	Kessem Sugar Factory (KSF)	Pay compensation to villagised households for land allocated to sugar plantation until they have received irrigable land, prepare land for irrigation, provide and manage irrigation water, develop infrastructure, and create market linkages for sugarcane.
Amibara	Amibara *Woreda* Land Administration Office	Receive land from private investors (e.g. in Bedula-alie and Badahamo), prepare new irrigable land including irrigation networks/ditches (e.g. in Angelele and Asoba), and distribute land to villagised households.
	Woreda Agricultural Office	Provide motor pumps and prepare land for farmers using tractors.
	Awash River Basin Authority	Undertake irrigation water management, including water allocation, water quality control, ditch clearance and maintenance, and flood protection.

Figure 3. Variation in the type and quality of houses constructed between villages in Awash Fentale. (a) Houses made of cement bricks in Doho, (b) Houses made of wood and mud in Saburie, and c) No house construction in Boloita, leading to self-build of traditional houses. Authors' photographs.

nor house construction by the *woreda* administration (Figure 4). Also, Amibara *woreda* had implemented clan-based land distribution, so those who did not belong to a clan were ineligible to receive land and thus unable to practice irrigated farming. Villagers were free to grow crops of their choice but the project did not establish market linkages for their products. Similar to Awash Fentale *woreda*, there were variations between the villages. For example, the size of land allocated for each household varied between 0.5 ha (e.g. in Bedula-alie) and 1 ha (e.g. in Badahamo). Some villagers in some *kebeles* (e.g. Badahamo, Bedula-alie and Awash Sheleko) were provided with irrigation water free of charge from state irrigation canals through gravity systems, while other villagers in other *kebeles* (e.g. Angelele, Asoba and Ambash) had to pay for fuel in order to use motor pumps given by the government to withdraw water from the Awash River (although the motor pumps were provided as part of the villagization project, which is not the case in non-villagised *kebeles*).

Most of the programme components (e.g. land preparation, water infrastructure, basic infrastructure) were organized and provided by the relevant *woreda* offices (Table 2). For example, *woreda* land administration and agricultural offices undertook land preparation and irrigation network construction in the villages (e.g. Angelele and Asoba). The *woreda* agricultural office was also responsible for providing agricultural inputs, training and extension services. The Awash River Basin Authority (ARBA) was responsible for water allocation and management in the villages established along the state irrigation canals (e.g. in Badahamo and Bedula-alie).

4.2. Implementation and expectations of villagization

In both *woredas*, most of the villagers were familiar with the villagization programme, as its general principles, plan and benefits were explained through awareness raising activities. Therefore, many people had been positive about the programme at the beginning and agreed to participate in it. For example, as stated:

> We were informed about the villagization programme by the government, and, as we were told, the plan was to settle pastoralists in one centre by constructing all the necessary infrastructure like houses, water points, and land and water for irrigated agriculture (participant from Boloita, Awash Fentale).[1]

> We were made aware about the villagization programme by *woreda* administrators. They also informed us about the government plan for the pastoral areas (participant from Badahamo, Amibara).

This general sense of satisfaction initially was apparently related to the promise of villagization to make water, irrigable land, and infrastructure and services available to the community. However, during and after villagization, participants started to develop mixed feelings, which varied depending on the performance of the plan, perceived benefits to their livelihoods, and the extent to which their expectations were met. Households that obtained access to land and water for irrigation, and in particular women who received land titles, seemed positive towards the programme, while others stressed that several promises remained partially or wholly unfulfilled: construction of houses, development of nearby grazing land, provision of 1.25 hectares of irrigable land and water, payment

Figure 4. Traditional houses in Angelele, Amibara. Authors' photograph.

of compensation for relinquished land, and provision of job opportunities (both FGDs in Boloita, Awash Fentale). Villagers in both *woredas* claimed that the resource distribution was uneven and partial, with some potential recipients being excluded. Some villagised households (e.g. Boloita, Doho and Badahamo) allege that they were unable to meet their food and other livelihood needs, and, as a result, returned to their previous lifestyle, while others migrated to other *kebeles*, thus dropping out altogether from the villagization programme.

A wide range of views were expressed during our FGDs and KIIs:

> We were happy as the new programme transformed us from pastoralists to agro-pastoralists. Now we have farmland in our village and we produce different food and cash crops (e.g. maize, onion, tomato) and fodder for some of our livestock. This programme has also transformed us from mobile to (semi) sedentary people, and it is better than continually moving from place to place. Previously, we used to herd our cattle over very long distances early in the morning and return home late in the evening. But now we have our house, we also have water, a health post for our community and school for our children (participant from Bedula-alie, Amibara). On the other hand, it was stated as:
>
> We are not very happy after we came to this village. Previously the agricultural and pasture lands were separate and there was sufficient pasture for our livestock. But now all the surrounding area is covered by sugarcane plantations and we face pasture scarcity. As a result, we are forced to travel long distances to find pasture for our cattle (participant from Doho, Awash Fentale).
>
> Now we stopped thinking about life on earth and are waiting for our afterlife [death]. You have found us here alive only because we have some food aid (participant from Boloita, Awash Fentale).
>
> We have neither been able to efficiently practice crop farming nor livestock rearing, we are now stuck in between (participant from Boloita, Awash Fentale).

4.3. Access to water for domestic and livestock consumption

Water was the most important resource constraint for domestic life, livestock and crop production. Before villagization, pastoral communities used to depend on natural water sources (rivers, springs, and ponds), both for human and animal consumption. In Awash Fentale *woreda*, Kebena, Bulga and Kesem Rivers and the Doho Hot Spring were the main water sources (Table 3). Women used to travel long distances (2–5 h per day) to fetch water for domestic use, often carrying their children on their front and water on their back. In Amibara *woreda*, the pastoral community used to get water for domestic and livestock uses from the Awash River and irrigation canals, with women also travelling long distances (4–6 h per day). Men also had to travel with their livestock (in the dry season), sometimes even for a whole day in search of water. In the wet season, both people and animals could drink rainwater collected in natural and artificial ponds around their traditional villages, but people used to suffer frequently from water-related diseases, particularly children and pregnant women.

Our findings suggest that villagization has for the most part improved both access both and the quality of water for domestic use in most of the villages. As our respondents highlighted, the government has developed boreholes to supply safe potable water (Table 3), implying that community members do not need to travel long distances for water for households and livestock. As two villagers explained:

> The quality and access to water sources between the present and the past are incomparable. Previously, there was no water source nearby, and women used to travel long distances to get water from springs and rivers for domestic use (participant from Boloita, Awash Fentale).
>
> We are now surrounded by water and we do not face any water shortages for domestic, livestock and irrigation use (participant from Boloita, Awash Fentale).

However, the effectiveness of the water supply schemes varies between the villages (Table 3). For example, ground water quality was poor in Doho and Saburie and could not be used for drinking. As a result, people reported that they still had to use unsafe water from irrigation canals for domestic and livestock purposes, resulting in disease (e.g. diarrhoea, cholera).

4.4. Access to water for irrigation

The new villages were established along the major river banks as well as existing and newly built state irrigation canals, in order to access water. In Awash Fentale, the villages get irrigation water from the Kesem Dam that was constructed to supply the sugarcane plantations. The villages in this *woreda* have a gravity irrigation system, and water allocation is managed by the KSF. In Amibara, villagers obtain irrigation water from the Awash River and existing irrigation canals connected to the Koka Dam upstream. While some villages (e.g. Badahamo, Bedula-alie and partly Ambash) have gravity irrigation systems from state irrigation canals (Figure 5a), others (Angelele, Asoba, Gelsa and Halaydegie) have to use motor pumps to abstract water from the Awash River (Figure 5b). The responsibility for allocation and management of irrigation water lies with ARBA, while the Agricultural and Pastoral Office of

Table 3. Comparison of water access before and after villagization.

		Previous water supply		Current water supply	
District/ woreda	Kebele	Water sources	Distance (time)	Infrastructure	Distance (time)
Awash Fentale	Boloita	Bulaga and Kebena Rivers, springs and ponds during rainy season	2–4 h	Borehole (hand pump)	1–2 min
	Doho	Bulaga and Kebena Rivers, Doho Hot Spring, and ponds during rainy season	4–5 h	Irrigation canals	1–2 min
Amibara	Bedula-alie	Awash River and irrigation canal, and ponds during rainy season	4–6 h	Borehole (electric pump)	1–2 min
	Badahamo	Irrigation canal, Awash River, and ponds during rainy season	2–3 h	Borehole (motor pump)	1–2 min

Figure 5. Water sources for irrigation; (a) state irrigation canal in Bedula-alie, (b) water withdrawal using motor pump from Awash River in Angelele *kebele*. Authors' photographs.

Amibara *woreda* is responsible for land clearance, distribution of motor pumps, and supply of agricultural inputs.

As mentioned earlier, households that could access irrigable land and water started farming both for domestic consumption (e.g. maize) and to supply to market (e.g. onion, tomato, cotton, watermelon, chilli) (Figure 6a-c). However, others failed to cultivate land. For example, in Bedula-alie only 10 out of the 61 hectares of the distributed irrigable land was cultivated, and, in Badahamo only 180 out of the 500 hectares. This was mainly due to shortages of water and the distribution of unprepared land, exacerbated by the absence of water diversion scheme s to the settlements and the low capacities of the diesel generators used to operate the motor pumps.

Moreover, some villagised communities did not start irrigation farming due to several reasons, including lack of access to irrigable land and water, lack of experience of crop farming, and delays in land preparation and distribution in some *kebeles*. The sugarcane plantation and related villagization programme in Awash Fentale created severe shortages of pasture and grazing lands for livestock as all the fertile communal rangelands (for both wet and dry season grazing) were converted to sugarcane. As a result, some pastoral communities there were neither able to practice irrigated farming nor traditional livestock rearing. In addition, the engagement of more people upstream in irrigated farming has also caused water shortages for downstream communities. This and other forms of competition for water have caused conflicts between water users, between upstream and downstream communities, between water users and water management institutions (e.g. ARBA), and between villages and officials from sugarcane plantations.

4.5. Water-related problems and hazards

Besides water access and use, a number of water-related problems and hazards were identified at the villagised sites: risk of floods and droughts, deterioration of water quality, soil salinity, and downstream water shortages.

Most of the villages situated close to and along the Awash River and irrigation canals have been exposed to the risk of fluvial and flash floods. The Awash River and its tributaries originate in the Ethiopian highlands, which receive high levels of rainfall and are thus prone to flooding downstream, affecting the study area. Aside from fluvial flooding, some villagised sites (e.g. Bedula-alie and Badahamo) have been affected by floods originating from irrigation canals when there was excess water flow from the Koka Dam. According to participants, flood s have become a yearly phenomenon in some villages that can damage settlements and farmland, make roads impassable, and pose risks to both human and animal lives. For example, flood events that occurred every year between 2014 and 2016 in Badahamo and Bedula-alie had caused significant damage to their crops, infrastructure and livestock.

Frequent droughts have decreased the water flow in the Awash River and its tributaries, lowered the water table, and reduced soil moisture in the MAV. These have caused shortages of water for pasture growth, irrigation, and drinking water for villages and livestock, despite the water resources and infrastructure provided to villagization projects. For example, the severe drought between 2014 and 2015 caused significant water shortages, resulting in significant losses of crops and animals (mainly cattle) in the villages (Figure 7a & b).

Figure 6. Crop farming in villagised sites; (a) maize in Angelele, (b) cotton in Bedula-alie, and (c) onions in Doho. Authors' photographs.

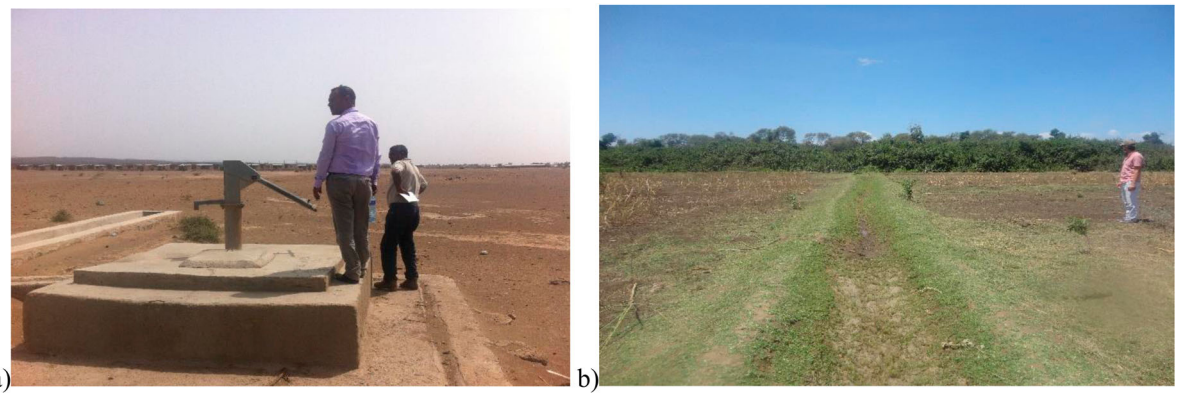

Figure 7. Water-related problems; (a) water point that ran dry in Saburie, and (b) waterless irrigation canal during the 2016 drought in Angelele. Authors' photographs.

While emphasis had been placed on providing water resources, poor water quality was a problem observed in the villages. The major sources of water pollutants included: fluoride in water from Lake Beseka, organic and inorganic pollutants from industries and urban centres (e.g. Addis Ababa, Adama, Mojo and Bishoftu), and saline groundwater sources. For example, saline groundwater was a major water quality problem in Doho in Awash Fentale (Figure 7a). Similarly, poor water quality from Lake Beseka has affected irrigation in Amibara, as one villager explained:

> … sometimes the colour of the water in the irrigation canals changes to the one we see in Lake Beseka [brown] and we become certain that the water has been released from Lake Beseka. Due to this, poor water quality for irrigation has become a common problem and we are unable to harvest crops as before (participant from Badahamo, Amibara).

Furthermore, soil salinity was observed in some irrigated farms, mainly in older farmlands. While agro-pastoralists would associate soil salinity with the release of water from Lake Beseka, local officials related it to the increased use of furrow or gravity irrigation. Local agricultural officials in Amibara indicated that some croplands were out of use due to salinity problem for which there was no management applied, apart from the invasion of *Prosopis juliflora*, which is a potential remedy. Nevertheless, soil salinization presents a threat to the sustainability of irriga ted agriculture, especially over the longer term.

5. Villagization, water resource development and adaptation to climate change

The stated intenton of this phase of Ethiopia's villagization programme was to enhance livelihood resilience of pastoral communities in drought-prone areas by improving food security, diversifying income sources, and delivering infrastructure and services to communities in the new villages (FDRE, 2013). Villagization was partly successful in developing basic infrastructure and services such as schools, health centres, rural roads, electrification, and water supply. In particular, the development of water infrastructure often reduced time spent fetching drinking water and searching for sources to water animals, especially by women. Those villagers who gained access to farmland and water for irrigation were usually able to increase their food security (animal and vegetable products), improve fodder production, and diversify their income. The potential for land ownership for women, and access to employment opportunities in the sugarcane plantation and KSF by some villagers, were also perceived benefits.

However, several structural factors and implementation issues led to uneven effects among participants, the recurrence of existing problems, and some new challenges for villagised communities. The forfeiture of existing land rights and the loss of grazing land as rangeland was converted to commercial agriculture led to pressure on remaining pasture. The livestock sector has been significantly overlooked and undermined by the programme in favour of irrigated agriculture. The villagization projects in both *woredas* appeared to have made very little or no attempt to develop pasture, improve herds, or increase the resilience of the livestock sector. We observed that most villagised communities continued to undertake seasonal migration with herds for pasture, resulting in new household divisions whereby women, older people and children remained at the village to tend the home and farmland, while men and youths travelled over long distance for months to maintain their livestock, especially in the dry season and during drought.

Many villagised households did not take up irrigated farming due to land and water shortages in both case study *woredas*. Those who either did not receive, or suffered delays in receiving, sufficient irrigated land and/or compensation were doubly affected by the loss of existing resources and the absence of replacements. Consequently, some members of villagised communities were neither able to properly practice irrigated agriculture nor continue with their traditional pastoral system, and thus became more prone to food insecurity and poverty under the programme (e.g. Doho, Boloita). In some cases, lack of access and partiality in land distribution, water allocation and compensation payment caused some households to withdraw from the villagization programme entirely.

While the development of and access to water resources was a primary feature of villagization, water shortages continued to occur as demand increased, leading to conflicts between users, and the capacity of some infrastructure was insufficient, being unable to supply adequate flows or overcome scarcity in dry periods. Water quality was not always adequate for the intended use, resulting in health effects and potentially leading to soil salinization, which could jeopardize the viability of

agriculture over the long term. Furthermore, the settlement of communities in close proximity to water courses exposed them and their animals to new flood risks.

Participants reported that agricultural services (farmer training centres, veterinary services, agricultural inputs), were relatively better developed at almost all villagised sites. In addition, for example, Worer Agricultural Research Center has been providing early warning and market information for local products at regular periods (commonly on a monthly basis) and has introduced different commercial and non-commercial crop varieties suited to pastoralist areas. However, the transition from pastoralism to agro-pastoralism was also challenging, in terms of adequate training, and need for inputs (seeds, pesticides, energy) in a timely and affordable manner. These factors were exacerbated by insufficient support for access to markets for products (directly or via local brokers), and vulnerability to market price fluctuations, which could be addressed by creating direct linkages with 'Consumers' Associations' established for customers in different areas and institutions, particularly in large neadrby cities such as Addis Ababa and Adama.

Some previous studies have argued that any development and climate adaptation initiatives should be designed in line withthe traditional pastoral livelihood system rather than seek to override it (Behnke & Kerven, 2013; Dong et al., 2011; Elias & Abdi, 2010; Gebeye, 2016; King-Okumu et al., 2015). This is also important in the context that some governments in sub-Saharan Africa have a tendency to consider pastoral lifestyles as primitive and in need of change. Such authors emphasize the need for intervention strategies that centre on the livestock sector and seek to support pastoral systems. For example, Gebeye (2016) proposes rangeland development and management, change or diversification of livestock composition, improved livestock productivity by introducing high-quality livestock breed, and improving livestock feed and establishing market linkages for livestock and livestock products. In our study area, removal and control of *Prosopis juliflora* could also beregarded as a key strategy to improve the productivity of rangelands to support the livestock sector (Haregeweyn & Tsunekawa, 2013; Mehari, 2015). As above, we acknowledge that the programme we examined focuses disproportionately on the development of irrigated agriculture – some of which directly benefits the Ethiopian Sugar Corporation – and that support for pastoral livestock and pasture was largely absent. However, our data also indicate a degree of demand from the pastoral communities for such interventions to ease certain aspects of their lives and to diversify their income given the environmental and political-economic challenges to pastoralism in their region (see also Little, Smith, Cellarius, Coppock, & Barrett, 2001; Mortimore, 2010; Pantuliano & Wekesa, 2008).

These studies also contend that villagization is not a feasible development plan for pastoral communities as it was planned to favour the introduction and commercial expansion of new state and private irrigation farming. Therefore, it is argued, villagization is an imposed development programme by the state that does not incorporate the interest of pastoral communities. Based on our analysis, we agree with certain elements of this argument. Villagization has been controlled by the state in line with a top-down approach, but, due to the nature of the institutional framework and governance in the country, most development interventions follow this style. Our data suggest that villagization was largely informed, voluntary, and welcomed by those pastoralist communities who opted for it in the MAV. As above, we further concur that the programme implemented in MAV placed much more emphasis on developing irrigated agriculture than it did on supporting existing pastoral practices, and that this did to some extent reflect a modernizing approach towards pastoralists, while also directly supporting to the interests of the state sugar industry in Awash Fentale (both through the reallocation of land from grazing to sugarcane, and the expectation that villagised communities would also grow sugarcane). Therefore, one observation is that adaptation has potentially come at the cost of the significant transformation of pastoralist communities and their lifestyles, livelihoods and cultures. One point of particular concern is the link between the villagization programme and the associated development projects with the dispossession and/or forfeiture of pastoral land. That pastoral communities have lost a significant asset (pasture) in favour of a development project that is uncertain in the present and/or future reflects an unequal trade-off.

This can be seen with regard to water. Water is considered as a determinant factor for the livelihood system in arid and semi-arid areas and water-centred development is seen as one of the most important ways to fundamentally enhance the development potential there (El-Beltagy & Madkour, 2012; Nassef & Belayhun, 2012). Water is also the primary medium through which climate change will impact people, ecosystems and economies. Hence focusing on water resources development and effective land-use planning is important to enhance the livelihood resilience of pastoral community and regions depending on rangelands (El-Beltagy & Madkour, 2012; GWP, 2009). In this regard, the villagization programme has largely contributed to increasing access to water both for domestic and livestock uses in most villages. Our findings also suggest that the introduction of irrigated farming has increased the resilience of those pastoral communities who have been able to access it, as it enabled them to increase their food security, improve fodder production, and stabilize and/or diversify their income. However, our data also reveal that water scarcity has not been resolved, with drinking and irrigation sources still running dry during periods of scarcity, leading to the same practices of migration with herds as before, but arguably under even more difficult conditions (reduction of grazing land, part of the family remaining in the village). Moreover, the study shows that new risks have been introduced, such as reliance on infrastructure (e.g. pumps, tractors) and commercial inputs (e.g. fertilizer, seed, pesticide), the obligation to coordinate water use with neighbours, and the risk of floods from settlement beside rivers.

6. Conclusion

There have been vigorous academic debates on the merits and contestations of resettlement schemes such as villagization. This paper has assessed the experiences and outcomes of water-centered villagization on adaptive capacity in the Middle Awash Valley, Ethiopia. We found that the principles of the programme were supported by participants, but that structural

factors and implementation issues led to uneven effects, the recurrence of existing problems, and some new challenges for villagised communities. Where provided, basic infrastructure and services enhanced villagers' quality of life, and those able to access irrigated agriculture were able to diversify their livelihoods. However, water shortages persisted at the villagised sites, and new problems and risks arose. Moreover, the programme was accompanied by the significant loss of grazing land, and, in some cases, land rights. This meant that pasture was scarcer, and that pastoralists' herding practices were as challenging or more so than previously.

These findings highlight the opportunities but also the substantial challenges of villagization to address water scarcity and promote adaptation to climate change. They highlight the need to attend to several structural factors that will be important in influencing outcomes, and that transcend issues of poor implementation (e.g. non-completion of facilities) or technical limitations (e.g. low-capacity generators). First, the need to adopt an equitable approach to resource allocation (e.g. irrigable land, water) across individuals, households, clans, communities, districts, and water users. Second, appropriate strategies to increase the resilience and productivity of the livestock sector, given its importance to both pastoralists (nutrition, income) and the commercial meat market (Gebeye, 2016) and agricultural products. Third, the long-term viability of irrigated agriculture in water-scarce environments with potential soil salinization. Fourth, attention to the potential sequential effects and/or unintended consequences of programmes, which may reproduce the same problems that they were designed to address (e.g. water shortages), or even increase vulnerability among the target groups (e.g. loss of land rights, exposure to flood risk). If these factors are addressed, villagization could make a greater contribution in increasing the resilience of pastoralist and agro-pastoralist communities (Hauck & Rubenstein, 2017; Manoli et al., 2014; Mortimore, 2010; Pantuliano & Wekesa, 2008).

Resettlement programmes can be interpreted as offering win-win-win situations between development, adaptation, and economic growth. However, the distribution of benefits and risks between households, villages, districts, as well as between people, state, and private sector, can be uneven, especially over the long term. Such programmes can also overlook the ways in which pastoral systems have adapted to arid environments over generations, and neither recognize nor address the environmental and political-economic drivers that have contributed to their instability (Few & Tebboth, 2018). As such, we argue that villagization may play a role in some aspects of adaptation to climate change, but that it is important to ensure that programmes address the underlying drivers of environmental and political-economic change, and guarantee that equity and rights are embedded in programme design and implementation.

Note

1. All quotations from participants have been translated from Amharic by the corresponding author.

Disclosure statement

No potential conflict of interest was reported by the authors.

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